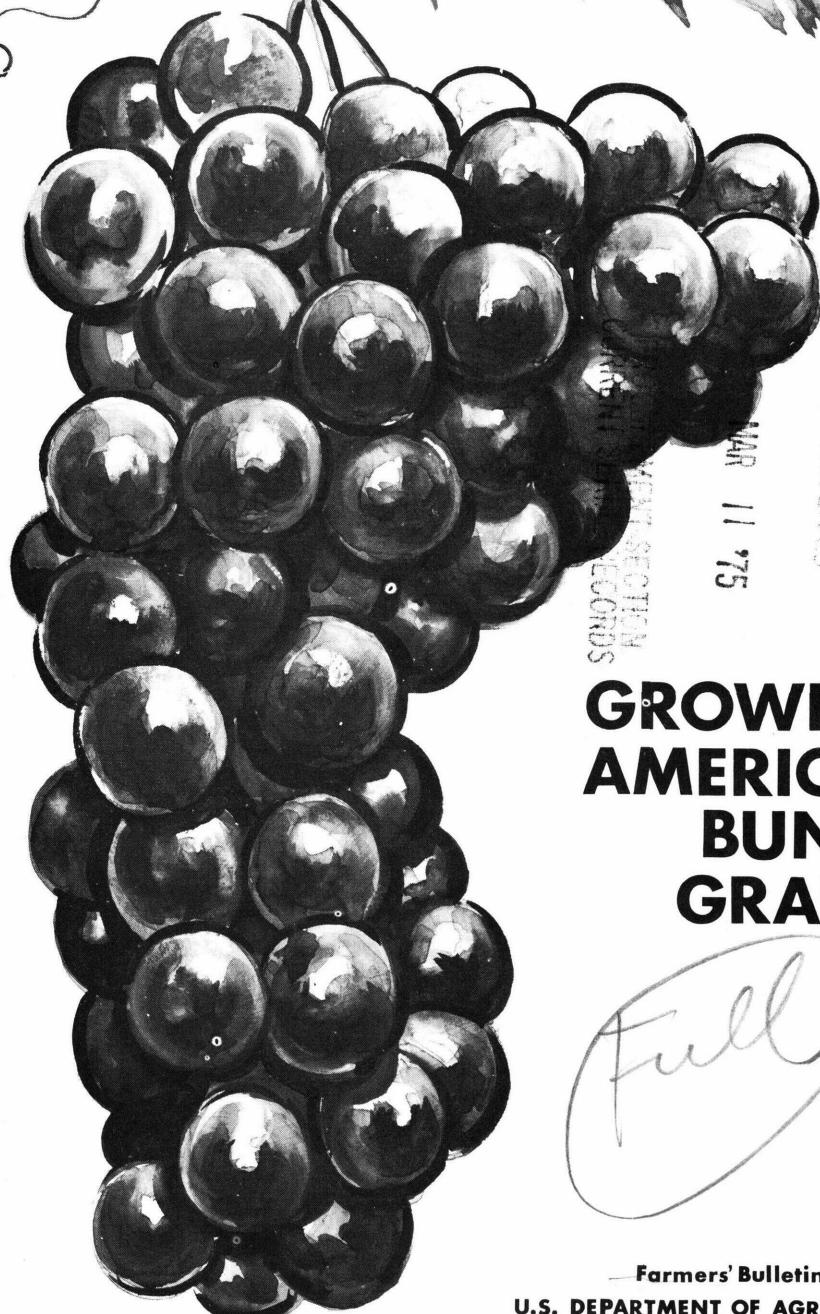


Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

Ag. 84F
Reserve

CD-3 LIB



U.S. DEPT. OF AGRICULTURE
NAT'L AGRIC. LIBRARY
AGRIC. LIBRARY
RECEIVED

MAR 11 '75

MISCELLANEOUS RECORDS

GROWING AMERICAN BUNCH GRAPES

Full

Farmers' Bulletin No. 2123
U.S. DEPARTMENT OF AGRICULTURE

CONTENTS

	Page
Major commercial production areas	1
Climate and soil	1
Varieties	2
Regional adaptation	3
Obtaining plants	4
Description of varieties	4
Vineyard	9
Selection of site	9
Land preparation	10
Propagation	10
Cuttings	10
Rootstocks	11
Planting	12
Trellis construction	13
Training and pruning	13
Training systems	13
Pruning	19
Tying fruiting canes	20
Renewing trunks	20
Treatment of frost-injured vines	20
Soil management	21
Cultivation	21
Fertilizers	22
Cover crops	22
Chemical weed control	23
Winter protection	24
Harvesting and fruit maturity	24
Insects and diseases	25
Precautions	25

Washington, D.C.

Revised December 1974

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 40 cents
Stock Number 0100-03266

Growing American Bunch Grapes

By J. R. McGREW, Northeastern Region, Agricultural Research Service

The grape varieties known as American bunch grapes were derived primarily from wild grape species native to North America. Most have some mixture of European varieties in their ancestry.

Although American bunch grapes make up only about 10 percent of the total United States grape crop, they are grown over a far wider area than other types of grapes—*vinifera* (European grapes) and muscadine grapes. *Vinifera* grapes are grown in California and other Southwestern States; muscadine grapes are grown in the South Atlantic and Gulf States. Varieties of American bunch grapes are available to suit most climatic conditions.

American bunch grapes are an important commercial fruit and also one of the most popular and extensively grown fruits in home plantings. They are easy to grow, bear early and regularly, and are small but long-lived plants. Insects and diseases are usually easily controlled.

The grapes are grown for fresh fruit and for wine, juice, jams, jellies, and frozen products.

MAJOR COMMERCIAL PRODUCTION AREAS

American bunch grapes are grown commercially in at least three-fourths of the States, but most of the commercial crop is produced in several well-defined districts.

The major commercial areas are along the eastern and southern shores of Lakes Michigan, Erie, and Ontario; the Finger Lakes section of New York; the lower Hudson River Valley; the south-central section of Washington State; the Ozark section of Arkansas and Missouri; the Missouri River Valley in Nebraska, Kansas, Iowa, and Missouri; and western North and South Carolina.

The above plantings are primarily the Concord variety, which is used for unfermented juice. An increasing acreage is being planted with varieties for wine.

CLIMATE AND SOIL

Growing American bunch grapes is limited or entirely unsatisfactory only in—

- Arid sections without irrigation. Production is often limited in the West and Southwest by lack of rainfall or water for irrigation.
- Locations with very short growing seasons.
- Locations with extremely severe winter temperatures.
- Areas having high temperatures and extremely high humidities. The grapes are susceptible to several diseases which thrive under hot, humid conditions.

The major commercial areas are located where (1) the growing season is 150 to 180 days, (2) the relative humidity is low, and (3) summer rains do not occur often but soil moisture does not become critically deficient. Rainfall near the time of maturity can adversely affect the quality of the fruit and may cause the fruit of certain varieties to crack, resulting in serious losses.

Grapes will grow in many different soils. The fertile, deep, and well-drained loams are best, but soils that contain sand, gravel, shale, slate, or clay can be used. Soils underlain with hardpan are not well adapted, nor are those that are shallow and underlain with gravel or sand. Avoid extremely wet or extremely dry soils. Vine growth is usually improved by organic matter in the soil.

Bunch grapes are adapted to a fairly wide range of acid to moderately alkaline soils. If the soil pH is below 5 (highly acid), liming will usually improve growth. If the soil pH is above 8 (highly alkaline), it may be necessary to

use rootstocks adapted to alkaline soils.

Good drainage is essential; if the land is not well drained it is not good grape soil regardless of other desirable soil characteristics.

The soil exerts considerable influence on the crop. Excessively rich soils and those with a high organic content produce a heavy but later-maturing crop with a low sugar content. Light soils tend to produce light yields of early-maturing fruit with a high sugar content and a comparatively weak vine growth.

VARIETIES

American bunch grapes are complex hybrids of several native American species and the European *Vitis vinifera*.

Varieties derived mainly from *V. riparia*, the frost grape, are adapted to northern areas. The fruit tends to be small but ripens early, and the vines are extremely cold hardy.

Varieties derived mainly from *V. labrusca*, the fox grape, include many of the varieties best adapted to the northern and central areas. The fruit is large and usually has some of the "foxy" flavor characteristic of Concord.

Most varieties adapted to the South are derived from the species *V. rupestris*, *V. champini*, *V. lincecumii*, and *V. bourquiniana*. The fruit is medium size and ripens late. The vines sometimes lack winter hardiness.

Varieties adapted to the severe disease conditions of Florida and

the Gulf Coast area are derived from *V. Simpsonii* and its relatives.

Varieties which have a high percentage of *V. vinifera* in their parentage usually have better quality fruit for table or wine use than varieties derived mainly from the American species. However, *V. vinifera* parentage increases susceptibility to diseases and insect damage. Therefore, choice of a variety is usually a compromise between the fruit quality of *V. vinifera* and the ease of culture of the American species.

The older varieties of American bunch grapes are derived mainly from native American species and have fair to excellent resistance to pests and diseases. Some of the more recent varieties are crosses of American types with *V. vinifera*. Although these varieties have improved fruit quality, many have low resistance to one or more diseases.

The varieties known as hybrid direct producers, or French hybrids, are used primarily for wine production. These varieties have been developed in France over the past 80 years by crossing American varieties or species with *vinifera* varieties. Selection has been based on resistance to foliage diseases and the phylloxera root louse, high production, and suitability for wine. *V. labrusca* has not been used extensively in the development of these hybrids because it has a strong flavor and only moderate resistance to phylloxera.

About 2,000 acres of hybrid direct producers are grown in the

United States, compared with 50,000 acres of Concord.

The hybrid varieties are generally referred to by the name or initials of the originator followed by his selection number. About 50 have been given names. Thus Seyve-Villard 5-276 may also be referred to as S.V. 5-276 or Seyval Blanc.

Regional Adaptation

Factors to consider when choosing grape varieties for a given location include:

Minimum winter temperature.—Varieties differ in their ability to survive low temperatures. This ability depends on the genetic origin of the variety and on conditions which affect the maturing of the vines in the fall.

Growing season.—Varieties also differ in the number of frost-free days required for the fruit to develop and ripen.

Time of ripening is a general indication of where a variety can be grown successfully.

Midseason varieties ripen about the same time as Concord and have a fairly wide area of adaptation. Concord requires at least 170 frost-free days to reach proper maturity.

The early-ripening varieties ripen 2 to 4 weeks before Concord and are grown in areas that are cooler or have a shorter growing season than the midseason area. These areas may be either farther north or at higher elevations. Early-ripening varieties grown in long-season conditions will ripen

during hot weather and may have poor quality, flavor, and color.

Late-season varieties are best adapted to the South, where there is a long, warm growing season. Late-ripening varieties grown in short-season conditions will not ripen in most years. In the mid-season area they generally produce good-quality fruit but may not ripen sufficiently in some seasons.

Vineyard site.—A favorable site often permits a variety to be grown much farther north than it could be otherwise. In a poor site, varieties which do well in the general area may fail.

Disease and insect resistance.—Varieties that are susceptible to diseases or insects may not be successful in as wide an area as varieties that are resistant.

Economics.—If you depend on an annual income from the grape harvest, select varieties carefully. Choose from varieties that have proved successful in the local area. Be sure there is a market for the varieties you select. If you are interested in growing a variety that has not been fully tested locally or that does not have an established market, try it out on a small scale.

If you are willing to risk an occasional crop failure, you can choose from a much larger number of varieties.

Obtaining Plants

All of the varieties listed in this bulletin have recently been available from nurseries. Most nurser-

ies carry a few popular bunch grape varieties. There are also several nurseries around the country which specialize in grapes.

Description of Varieties

The following descriptions include fruit color, time of ripening (early, midseason, or late), characteristics, use, and general pruning recommendations.

Names of hybrid direct producers (French hybrids) appear in italics.

Fruit color is indicated by the following letters: (B) = blue or purple; (R) = red; and (W) = white or greenish.

Areas of adaptation for early, midseason, and late varieties are shown in figures 1 through 3. A few varieties are recommended only for the Florida and Gulf Coast area (fig. 4).

For detailed information about pruning, see page 19.

Beta (B).—Very early. Vigorous; productive; very hardy. Small clusters and berries with high sugar and high acid. Wild taste. Used primarily for juice and jelly. Prune to long canes.

Blue Lake (R).—Recommended only for the Florida and Gulf Coast area, where it is early mid-season. Medium clusters of small berries with unusual aromatic-spicy flavor suitable for juice and jelly. Does not ship or store well. Prune to medium canes.

Caco (R).—Midseason. Very vigorous; moderately productive;

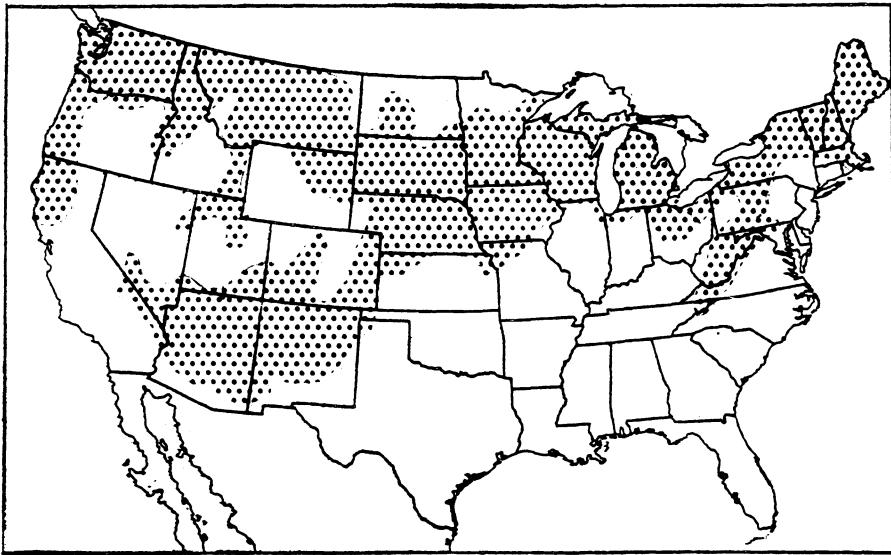


Figure 1.—Areas where early-ripening varieties are adapted.

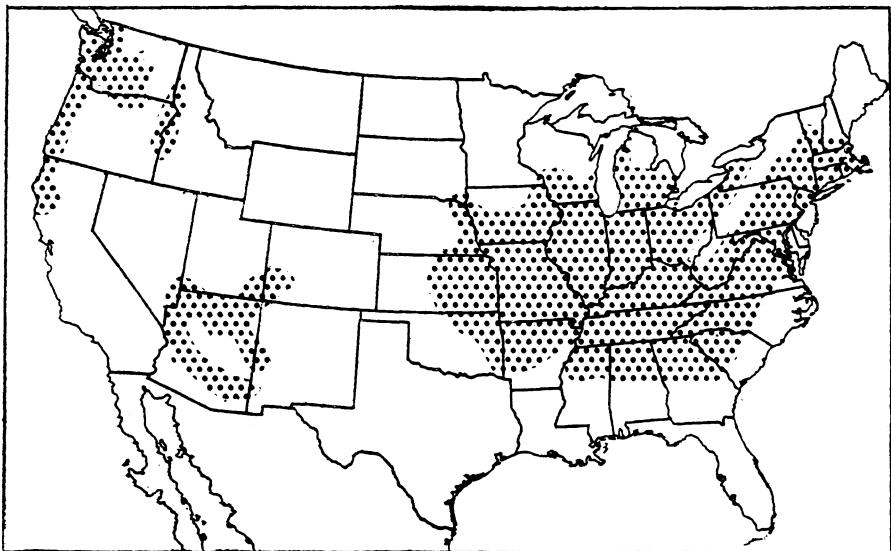


Figure 2.—Areas where midseason varieties are adapted. These are also the areas where Concord is generally grown.

hardy. Suitable for table use and roadside markets. The berries are large but the fruit quality is mediocre. Prune to long canes.

Campbell Early (B).—Early midseason. Moderately vigorous; moderately productive; fairly hardy. Clusters medium to large,

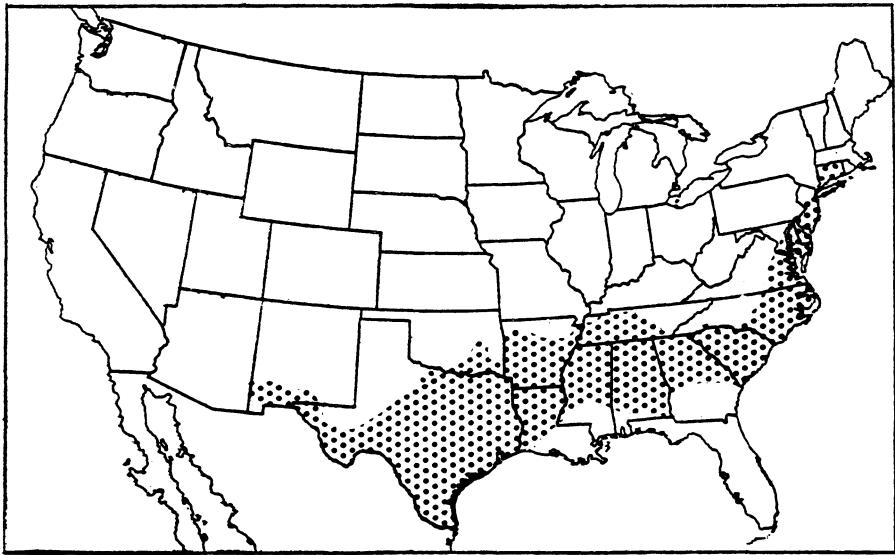


Figure 3.—Areas of adaptation for late varieties.

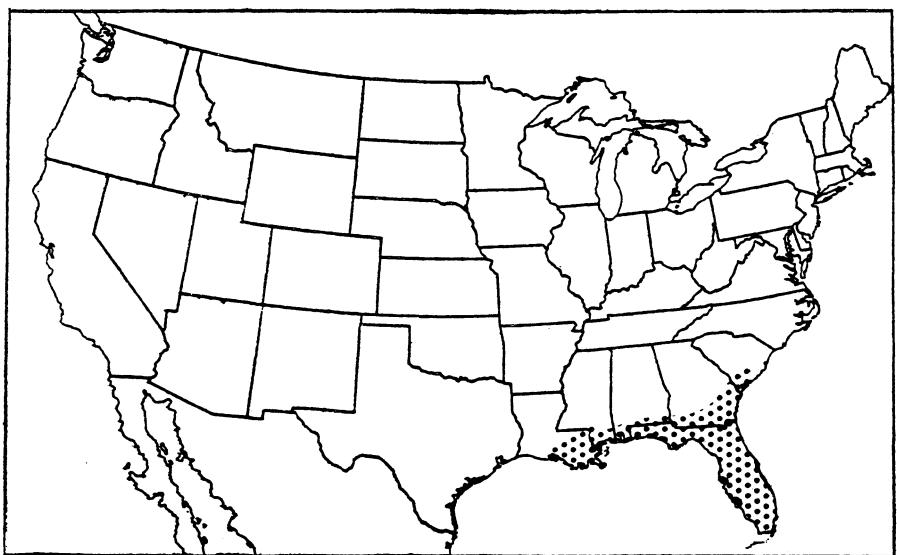


Figure 4.—The Florida and Gulf Coast area. Varieties adapted to this area do not grow well in other regions.

sometimes with poor set. Berries medium. Used commercially in the Pacific Northwest for juice and jelly. Prune to long canes.

Catawba (R-B).—Late midseason. Vigorous; productive; hardy. Large clusters and berries. Grown commercially for wine, but also

suitable for juice and table use. Prune to medium canes.

Concord (B).—Midseason. Vigorous; productive; hardy; disease resistant. Medium clusters of medium-large berries. The leading commercial variety, used primarily for juice, jelly, and specialty wines. Prune to long canes.

Concord Seedless (B).—Midseason. Low vigor; moderately productive; hardy; disease resistant. Small clusters of small, almost seedless berries with typical Concord flavor. Probably a sport of Concord. For table use or grape pie. Prune to medium canes.

Delaware (R).—Late midseason. Medium to low vigor; fairly productive; hardy. Medium-small clusters of small berries, which are often picked while still pink. Will ripen to mahogany color with high sugar content. Standard of quality for table use. Prune to medium-long canes.

Ellen Scott (R).—Late. Vigorous; productive; only moderately hardy. Susceptible to disease. Medium-large clusters of large berries. A juice and table variety for warmer areas. Prune to medium canes.

Fredonia (B).—Early midseason. Vigorous; productive; hardy; disease resistant. Medium to small clusters of large berries. Flavor similar to Concord but milder. Prune to long canes. A large-clustered sport of Fredonia, such as McCampbell, is recommended for roadside markets.

Golden Muscat (W).—Late midseason. Vigorous; moderately productive; moderately hardy.

Large clusters of medium berries with a somewhat foxy-muscat flavor. Table variety. Quality of fruit suffers in hot seasons. Prune to medium canes.

Himrod (W).—Early midseason. Vigorous; productive; only medium hardy. Requires careful spraying. Large, loose clusters of medium-size, oval, nearly seedless berries. Table variety, very popular for roadside markets. Prune to medium canes.

Interlaken Seedless (W).—Early. Moderate vigor and production. Somewhat cold tender, especially if allowed to overproduce. Requires careful spraying. Medium clusters of small, nearly seedless berries. Table variety, very popular for roadside markets. Prune to medium canes.

Joannes-Seyve 23-416 (no name given) (W-R).—Late midseason. Very vigorous; moderate production; good disease resistance. Large, loose clusters of oval, pinkish berries. Wine quality good in southern Concord area. Prune to medium canes.

Joannes-Seyve 26-205 (Chambourcin) (B).—Late midseason. Moderate vigor; productive; disease resistant; large clusters. Wine good in southern Concord area. Prune to short canes.

Kuhlmann 188-2 (Foch or Marechal Foch) (B).—Very early. Moderate vigor and production. Small, tight clusters of small berries. Fair disease resistance. Very good wine when grown in cooler areas. Subject to severe bird damage. Prune to long canes.

Landot 244 (Landal) (B).—

Midseason. Moderate to good vigor; moderate production; fair disease resistance. Medium-size clusters. Wine quality very good when fruit is allowed to ripen fully. Prune to medium canes.

McC Campbell (B).—See *Fredonia*.

Moore Early (B).—Early midseason. Moderate vigor and low productivity; hardy. Medium clusters with large berries. A Concord type that ripens about 2 weeks earlier than Concord. Fruit not as good in quality and often cracks badly. Prune to medium canes.

Niagara (W).—Midseason. Vigorous; productive; hardy; disease resistant. Medium-size, compact clusters of large berries. Flavor foxy. Suitable for table use. Prune to long canes.

Ravat 51 (Vignoles) (W).—Early midseason. Vigorous; moderately productive; very hardy. Requires careful spraying. Clusters small, very compact, and subject to ripe rots. Wine quality very good in cool areas although acid may remain high. Prune to long canes.

Seibel 4986 (Rayon d'Or) (W).—Late midseason. Moderately vigorous; somewhat cold tender. Consistent, though moderate, production of medium to large compact clusters. Medium-size berries are pink at maturity. Good resistance to foliage diseases but subject to fruit rot. Wine quality fair in northern areas to very good in central area. Slightly foxy in hot, dry seasons. Prune to short canes.

Seibel 5279 (Aurore) (W).—

Early. Vigorous; productive; hardy; moderate disease resistance. Medium-long, loose clusters. Good quality wine when grown in cool area. Prune to medium canes.

Seibel 7053 (Chancellor) (B).—Late midseason. Vigorous and productive. Must be sprayed carefully. Clusters medium and slightly loose, berries medium. Wine quality bland when grown in southern Concord area. Prune to short canes.

Seibel 9110 (Verdelet) (W).—Midseason. Vigorous; variable production; somewhat cold tender. Requires careful spraying. Large, loose clusters of oval berries which are excellent for table use. Wine quality fair to good. Prune to short canes for best clusters.

Seibel 9549 (De Chaunac) (B).—Early midseason. Moderately vigorous and productive with long, loose clusters of medium-size berries. Very good wine when grown in northern and central areas. Prune to medium canes.

Seibel 10868 (no name given) (W).—Midseason. Vigorous and productive. Requires careful spraying, especially late in season. Medium-large clusters with small, pinkish berries. Wine quality very good in cool areas, tending to foxy in warmer areas. Prune to short canes.

Seibel 10878 (Chelois) (B).—Midseason. Vigorous; productive; somewhat cold tender; disease-resistant foliage. Medium-large clusters. Wine quality good in cool area, fair in warmer areas. Prune

to medium-short canes to prevent overproduction and weakening of vines.

Seibel 13053 (Cascade) (B).—Very early. Hardy; moderately productive; moderately disease resistant. Clusters medium to small with medium berries. Fruit color pale unless left until fully ripe. Wine quality good in cool areas, poor in warm areas. Especially subject to bird damage. Prune to medium canes.

Seneca (W).—Early. Moderately vigorous; productive; moderately hardy. Susceptible to powdery mildew but resistant to ripe rots. Medium-size clusters with oval, crisp berries of excellent table quality. An outstanding variety with proper disease control. Prune to medium canes.

Seyve-Villard 5-276 (Seyval Blanc) (W).—Early midseason. Moderately vigorous; productive. Large clusters, good foliage. Disease resistant but subject to rotting of ripe fruit. Very good wine. Must be short-pruned.

S.V. 12-375 (Villard Blanc) (W).—Late. Very vigorous; highly productive; highly disease resistant. Clusters medium to large, acceptable for table use. Wine good in southern Concord area. Prune to short canes.

S.V. 18-315 (Villard Noir) (B).—Late. Vigorous in warmer areas; productive; disease resistant. Medium-large clusters. Wine very good in southern Concord area. Prune to short canes.

Steuben (B).—Late midseason. Vigorous; productive; medium hardy; disease resistant. Moder-

ately large clusters of medium berries. Pleasant spicy-muscat flavor excellent for table use. If slightly overcropped, fruit remains red and vine is subject to cold damage. Prune to medium canes.

Stover (W).—Recommended only for the Florida-Gulf Coast area, where it is early, moderately vigorous when grafted, productive, and hardy. Resistant to Pierce's Disease but must be sprayed for foliage diseases. Medium clusters of medium-size, oval berries which hold in storage better than Blue Lake. Table variety. Prune to medium canes.

Vidal 256 (no name given) (W).—Late. Very vigorous; productive; fair disease resistance. Handsome long clusters with small berries. Can produce a fair secondary crop if frost destroys primary clusters. Wine quality good to very good in southern Concord area. Prune to medium canes.

Worden (B).—Early midseason. Vigorous; productive; hardy. Medium-large clusters of large, Concord-type berries. Not so widely adapted as Concord, but of equal quality. Subject to fruit cracking. Prune to long canes.

VINEYARD

Selection of Site

For the vineyard, select a relatively frost-free site with well-drained soil. Level or gently sloping land that is somewhat elevated is best. Steep slopes are subject to erosion, are unsuited to mechanical harvesters, and make

spraying difficult during wet periods, when disease control is most important.

Sites to the south and east of large lakes are very favorable. Large bodies of water change temperature slowly and have a moderating effect on the surrounding area; summers are cooler and winters are warmer. On such sites, plant growth may be retarded enough in the spring to avoid injury from late frosts, and frosts are delayed in the fall.

Grapes blossom and mature earlier on southern and eastern slopes than on northern slopes. However, on the colder northern slopes, growth may be retarded enough in the spring to avoid injury from late frosts. Western slopes are exposed to prevailing winds, which in some areas may be strong enough to cause damage. Where the rows run east and west as on a northern or southern slope, prevailing winds from the west dry the dew and rain from the foliage quickly, which helps to prevent diseases.

Direction of the slope may be important at the northern limit of a variety's range where a few days' delay in ripening may cause a crop loss; elsewhere, it is a minor consideration.

Land Preparation

If the vineyard land has been in sod or has not been cultivated for some time, grow a row crop for at least one season before preparing the land for grapes so that weeds will not be so difficult to control.

Before planting the grapes,

plow the land deeply and disk it until the soil is well pulverized.

Straight rows are desirable, but plant on the contour to prevent erosion if necessary. Where required, contour planting is well worth the extra time required to lay it out. Your county agricultural agent or your local technician for the soil conservation district can advise on land preparation for contour planting.

PROPAGATION

Vines of American bunch grapes are usually grown on their own roots—propagated from cuttings of the previous season's growth. However, rootstocks may be used to provide a root system resistant to phylloxera or nematodes or to increase the vigor of weak-growing varieties. Scion and rootstock may be joined by grafting or by chip budding.

Cuttings

Cuttings are usually taken from the previous season's growth. However, mallet cuttings—cuttings that bear a small portion, or heel, of 2-year-old wood—root more easily (fig. 5).

Cuttings may be taken from prunings anytime during the dormant season, but if taken early there is less chance of the wood being winter injured.

Select well-matured wood at least $\frac{1}{3}$ inch in diameter. Make the basal cut just below a bud. For varieties of the Concord type, select canes with buds 3 to 5 inches apart and make the cuttings

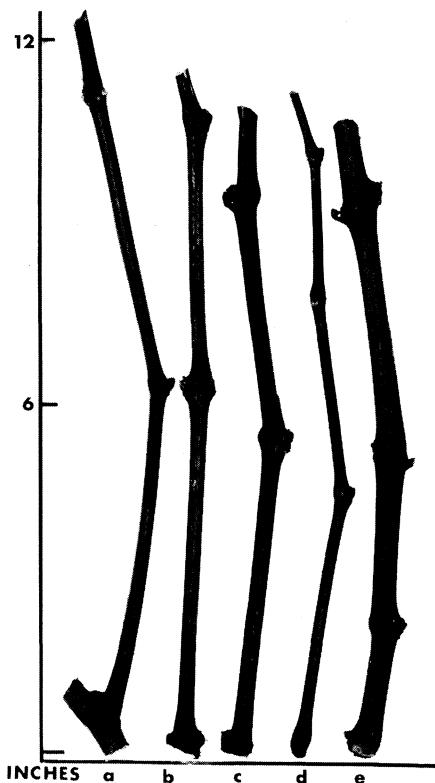


Figure 5.—a, Mallet cutting; b and c, good cane cuttings; d, thinner than optimum; e, thicker than optimum.

at least three buds long. For weaker-growing varieties, such as Delaware, select canes with shorter joints and leave more buds per cutting. To facilitate handling and bundling, make the cuttings of a variety approximately the same length regardless of the number of buds.

For ease in handling and planting, tie the cuttings into bundles of 25 to 100 with all buds pointing in the same direction. Bundles

may be stored by tying them with wire and burying them in well-drained soil. Bundles may also be stored in a cool cellar or under refrigeration (40° to 45° F.) Put the bundles in boxes of moist sand or sawdust to prevent cuttings from drying out. Small quantities can be stored in plastic bags with moistened sawdust, peatmoss, or paper towels.

In the South, cuttings may be planted in the nursery anytime from fall to early spring; in colder areas, plant in early spring. Plant before any root or shoot growth occurs on the cuttings.

The nursery soil should be well prepared, well fertilized, and free of weeds. Set the cuttings 4 to 6 inches apart in the rows, which may be spaced 2 to 4 feet apart. Plant the cuttings with one bud above ground and firm the earth around them. Where there may be alternate freezing and thawing, mulch cuttings set in the fall or winter to protect them from heaving.

Black plastic film can be used to control weeds in a nursery planting. Prepare the soil, then lay 3-foot-wide black plastic strips, burying the edges. Insert the cuttings through the plastic.

Rootstocks

Under some conditions, American bunch grapes do not grow well on their own roots and may be more successful if the vines are grafted to rootstocks of a different variety. Problems for which rootstocks may be helpful include:

- Phylloxera or nematode infestation of the soil.
- Soils poorly adapted to grapes.

- Lack of vine vigor.
- Excessive vine vigor, resulting in poor clusters or failure of the wood to mature in the fall.

Choice of a rootstock depends on the particular problem and on the variety of the vines. Not all combinations of vines and rootstocks are compatible.

The outstanding attributes of some of the common rootstocks are listed below.

Phylloxera resistance.—All rootstocks have some tolerance for phylloxera, but the following varieties are highly tolerant: C 3309, C 1202, 5 BB, SO4.

Nematode resistance.—C 1616, Dogridge, Salt Creek, Harmony.

Droughty soils.—99 R, 110 R, 333 EM.

Reduce vigor.—99 R, 110 R.

Increase vigor somewhat.—SO4, St. George, Harmony.

Increase vigor markedly.—Dogridge, Salt Creek.

Hasten wood maturity.—41 B, 101-14.

Delay wood maturity.—St. George, 110 R.

For more specific rootstock recommendations and for information on grafting techniques, consult your county agricultural agent or State agricultural experiment station.

PLANTING

In the South, vines may be planted as soon as they are dor-

mant in the fall. Fall planting allows the vines to start growth as soon as the weather permits, even though the soil may not be in condition to work.

In colder areas, fall-planted vines must be mounded with earth to protect against frost heaving and winter damage. Because of this extra work and possible loss of vines, early spring planting is generally preferred north of Arkansas, Tennessee, and Virginia. In spring, grapevines should be planted as soon as the soil can be worked so that they will be well established by the time the hot, dry summer weather arrives.

Set the strongest 1-year-old plants available. Two-year-old nursery plants are seldom worth the extra premium nurseries must charge for them. Two-year-old vines will not bear fruit any sooner than well-grown 1-year-old plants.

Plant grapevines about the same depth that they grew in the nursery, and prune them to a single stem two or three buds long.

For most varieties, including Concord, space the plants 8 to 10 feet apart in the row. Less vigorous varieties, such as Delaware, may be spaced 7 to 8 feet apart. Vines in single-row plantings are set the same distance apart as those in a vineyard. They may be more vigorous than those in a vineyard, because of less competition for nutrients and moisture.

Set two or three vines between wooden posts. Do not set vines against the posts because the roots may be injured when the posts are

replaced and the wood preservative in treated posts may be toxic to the plants. Where concrete or steel posts are used, the grape hoe is easier to use if vines are set at the posts and midway between them.

Set vines directly under the trellis; vines out of line may be constantly injured during cultivation.

TRELLIS CONSTRUCTION

The trellis consists of two or more wires attached to wood, concrete, or steel posts. Construction is essentially the same as for a sturdy wire fence.

Durable types of wood posts include black locust, Osage-orange, red cedar, white oak, and "fat" pine. Less durable types of wood may be treated with a preservative, such as creosote or pentachlorophenol, to increase their durability.

Reinforced concrete and heavy steel posts are expensive, but are the most durable type. Steel posts must be heavy enough to resist bending in a strong wind when the vines have heavy foliage. They should be used only in soils heavy enough to hold them in line.

If the vineyard is in an exposed area, an occasional steel post among wood or concrete posts will ground the trellis and may prevent damage to the vines from lightning.

End posts should be longer and heavier than line posts and must be well braced. Failure of an end post weakens the entire trellis. Set

end posts 3 feet in the ground and line posts 2 feet. In contour planting, line posts may require extra bracing.

No. 9 wire is ordinarily used for trellises, but the lower wires can be as light as No. 11. Staple the wires on the windward side of the posts. Do not drive the staples tight—allow the wires to slide under them to facilitate tightening. The wires should be tightened each spring before the vines are tied.

Vineyard rows are usually spaced 10 to 12 feet apart to allow free movement of cultural equipment without injury to the vines.

If mechanical harvesters will be used, leave at least 20 feet at the ends of the rows for turning.

TRAINING AND PRUNING

Training and pruning are interdependent operations. Young vines are trained to a system of growth on the trellis or other support by pruning. Mature vines are pruned to maintain the system of growth and to insure the production of good-quality fruit.

Training Systems

Four-Arm Kniffin

The four-arm Kniffin system (fig. 6) is the most popular one for bunch grapes. It gives good production, requires little summer tying, and is adapted to moderately vigorous varieties.

The trellis consists of two wires.

After the first growing season (during the dormant period),

FOUR-ARM KNIFFIN TRAINING SYSTEM

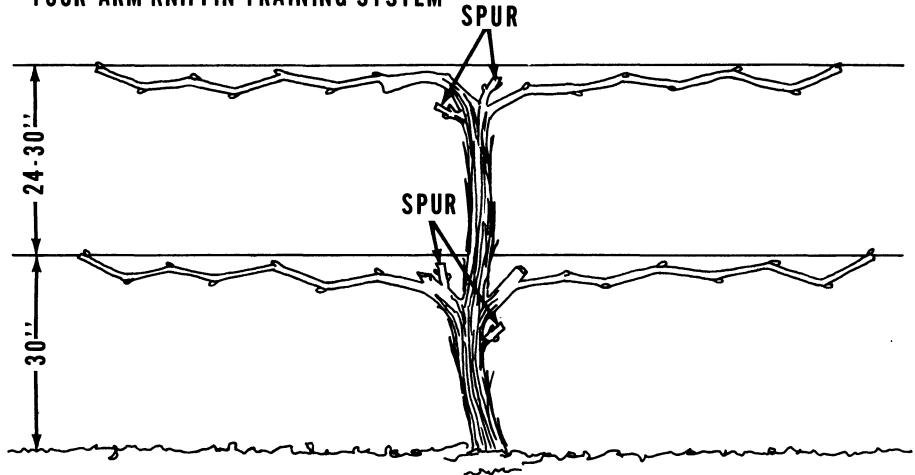


Figure 6.—The four-arm Kniffin training system is the most popular one for American bunch grapes.

select the most vigorous cane for the trunk and tie it to the top wire. Cut the cane off above the wire and remove all other canes. If no cane is long enough to reach the top wire, tie the strongest one to the bottom wire, and extend it to the top wire the following season. If no cane is long enough to reach either wire, cut the vine back to a single stem, two or three buds long and start anew.

After the second (or third) growing season (during the dormant period), select four vigorous canes for the arms. Prune the canes to approximately 10 buds in length (see "Pruning," p. 19), lay them down along the wires, and tie them. Cut four other canes back to two or three buds in length for renewal spurs. Remove all other canes.

Each winter thereafter, replace the arms with canes from the

renewal spurs, and leave new renewal spurs.

You can increase yield and hasten maturing of the fruit slightly by raising the height of the trellis to 6 feet or more and increasing the space between the wires. This exposes the growth to more sun and light. Where the growing season is very short, this modification could make the difference between a crop and a failure.

Umbrella Kniffin

Excellent quality fruit can be produced under the umbrella Kniffin system (fig. 7). And with vigorous vines, yield can be as great as that under other high-yielding systems.

The trellis is the same as that for the four-arm Kniffin system, or may have a third wire added, as shown in figure 7.

Train the vine to a single trunk

extending to just below the upper wire. After the second growing season (during the dormant period), select two to four canes growing from near the top of the trunk for arms. Prune them to 10 to 20 buds, depending on the number of arms left. Cut back two other canes to two or three buds for renewal spurs. Loop the arms over the top wire, bring them down obliquely to the bottom wire, and tie them. The shoots that develop during the next growing season droop off to the sides.

Each winter thereafter, replace the arms with canes from the renewal spurs and leave new renewal spurs.

Munson

The Munson system (fig. 8) is used in home plantings and in

experimental vineyards, but very little in commercial plantings. It is particularly suitable for humid climates, because the fruit is produced high above the ground where it is less subject to injury by diseases.

The trellis consists of three wires strung in the shape of a wide V. Two wires are attached to the outer edges of cross arms 18 to 24 inches wide and 5 feet above the ground. The third wire is attached to the posts, 6 to 8 inches lower.

Train the vine to a single trunk extending to the lower wire. After the second growing season (during the dormant period), prune to two or more canes (arms) and two renewal spurs. Tie the arms along the lower wire. As the shoots develop during the next

UMBRELLA KNIFFIN TRAINING SYSTEM

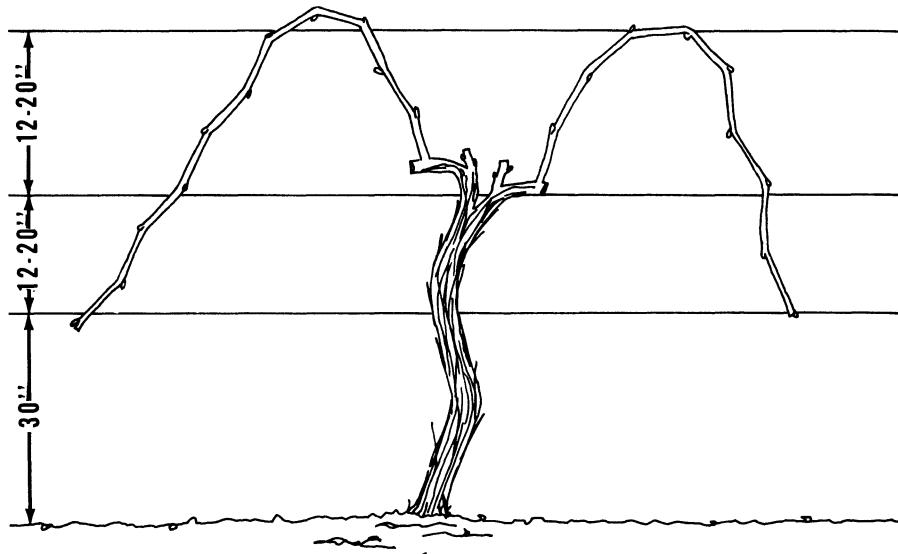


Figure 6.—The umbrella Kniffin training system can give good yield and excellent quality fruit.

growing season, distribute them over the upper wires, allowing them to hang down.

Each winter, replace the arms with canes from the renewal spurs, and leave new renewal spurs.

Geneva Double Curtain¹

The Geneva double curtain system was developed for vigorous vines of such varieties as Concord, Delaware, Niagara, and Catawba. Under this system, the shoots and leaves receive more exposure to the sun. This results in higher yield and better quality fruit.

Trellis construction is shown in figure 9. The important feature is the two top or cordon wires. One vine can be trained for 16 feet along one of these wires, while an adjacent vine in the same row can be trained for 16 feet along the other wire. Trellis space per vine is about double that under other training systems.

The vine trunk is trained to the lower wire (two trunks per vine are recommended for better utilization of the 16 feet of trellis space). From the trunk (or trunks), branches or cordons are developed and extended along the two cordon wires.

¹ The Geneva double curtain training system was developed by the Agricultural Experiment Station at Geneva, N.Y., for Concord and other bunch grape varieties popular in New York. More information about this system may be obtained from the Experiment station.

Parts of the Grapevine

Trunk.—The main perennial part of the vine.

Buds.—The conical swellings found at each node on shoots and canes.

Shoots.—The current season's growth of young wood. Shoots originate from the buds on the spurs and arms and bear the leaves, flowers, and fruit. As they mature, they are termed canes.

Canes.—The mature shoots of the current season or the dormant growth of the preceding season. Most of the canes are pruned off during the dormant season.

Arms.—The canes that are left after pruning and that produce the fruiting shoots and canes. At the end of the growing season, they are usually removed completely and replaced by new arms for the following season.

Cordon.—The horizontal perennial part of the vine along which fruiting spurs are distributed.

Renewal spurs.—Canes pruned to two or three buds. New canes from these spurs are selected for arms the following season.

Five-bud spurs and one-bud renewal spurs are maintained on each branch or cordon. If allowed to grow normally, shoots from these spurs would form a broad and dense canopy of foliage. Each year the shoots must be positioned by hand so that they will grow in a vertically downward direction to form a curtain of foliage sus-

MUNSON SYSTEM

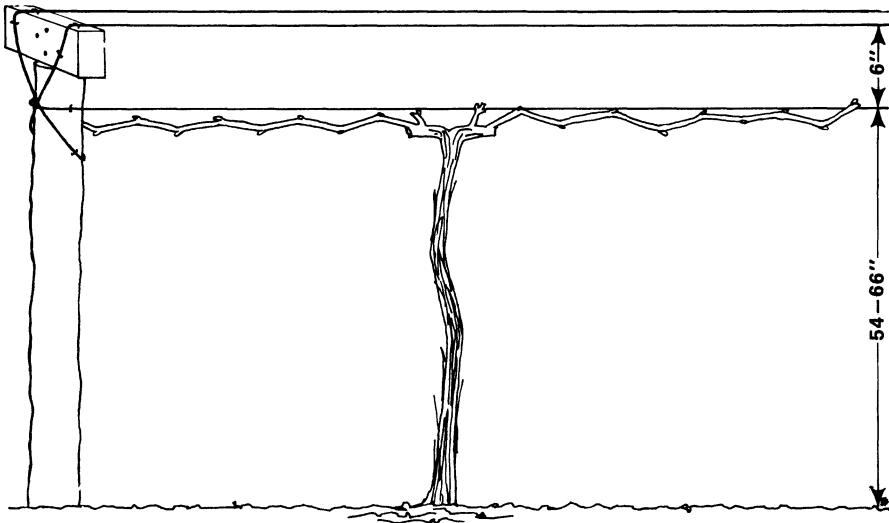


Figure 8.—The Munson training system is especially suitable for humid climates.

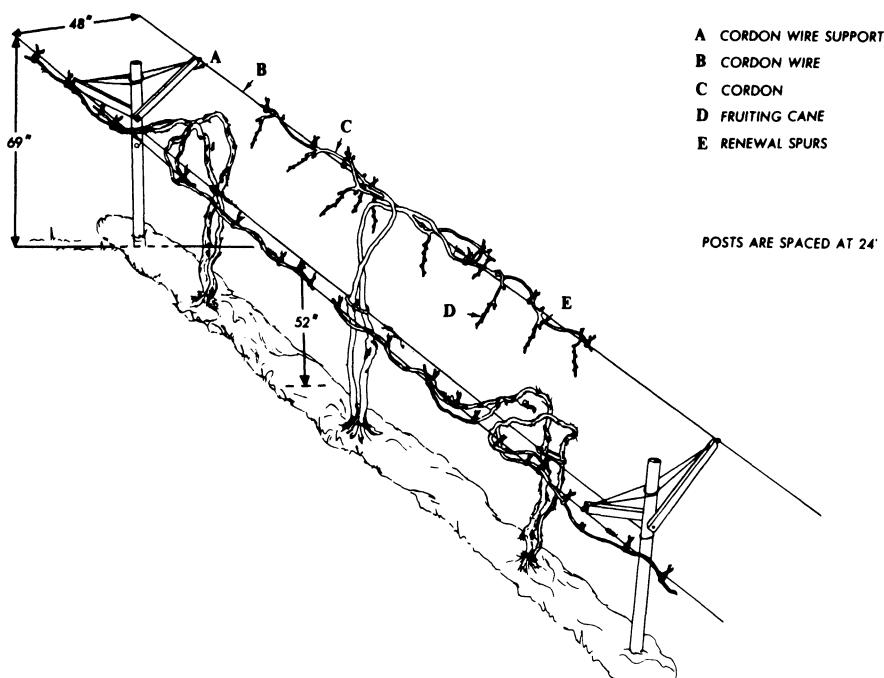


Figure 9.—With the Geneva double curtain training system, the shoots receive more exposure to the sun than with other systems. (Drawing from Bulletin 811, "The Geneva Double Curtain for Vigorous Grape Vines," New York Agricultural Experiment Station, Geneva.)

pended from each cordon wire. The final effect is a double curtain of foliage from each row of grapes.

The Geneva double curtain system gives increased yield both per shoot and per vine with no delay in maturing of the fruit. Also the fruit is in good position for harvesting either by hand or by machine. The increases in returns possible can offset the additional cost involved in building the trellis and positioning the shoots each year.

Keuka High Renewal

The Keuka high renewal system (fig. 10), also known as cane or head pruning, is well suited to varieties of hybrid direct pro-

ducers which produce upright shoots and should be pruned to short canes. It is not suitable for Concord and other American varieties that have a drooping growth habit or require long cane pruning.

The trellis consists of two or three wires.

Establish a single trunk extending to the bottom wire. After the second growing season (during the dormant period), select two canes and tie them along the bottom wire. Leave two renewal spurs at the bottom wire. As the shoots develop during the next growing season, tie them to the upper wire or wires.

To save tying all the individual shoots, run two wires—one under tension and one slightly slack—through the top staples. Place the

KEUKA HIGH RENEWAL TRAINING SYSTEM

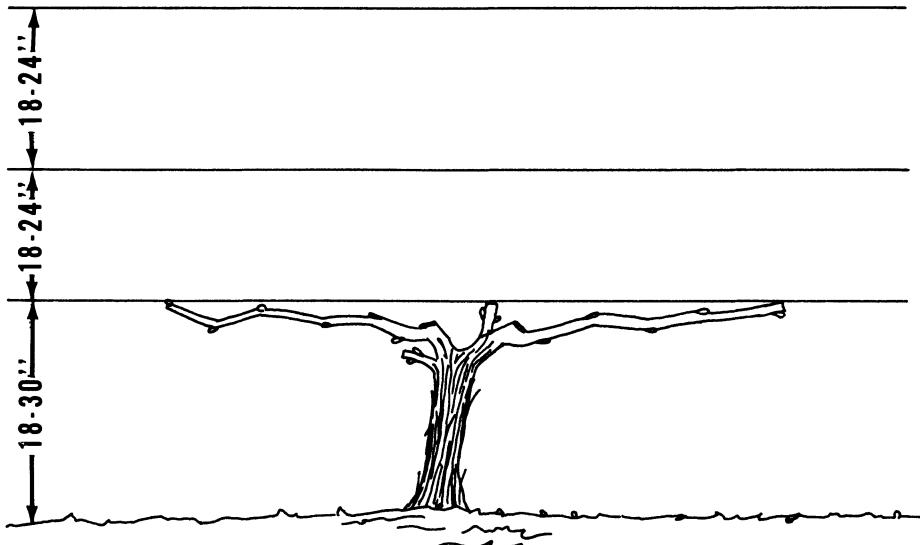


Figure 10.—The Keuka high renewal training system is well suited to many varieties of hybrid direct producers.

shoot between the two wires, give the slack wire a half twist, and repeat the procedure for the next shoot.

Each winter, replace the arms with canes from the renewal spurs and leave new renewal spurs.

Arbors

Arbors are seldom used in commercial plantings, but they are often constructed around homes to give shade and fruit.

When the vines are pruned to arms well spaced over the trellis, yields are very good. For quicker and more uniform covering of the arbor, the vines should be pruned to short spurs two to three buds long, although this procedure may reduce the size of the crop.

Pruning

Grapes require heavy annual pruning. Proper pruning is essential for consistent yields and good-quality fruit.

Pruning prevents overproduction of fruit by limiting the number of fruit-producing buds. Underpruned vines become weak and produce small clusters. If vines are overpruned, however, they become excessively vegetative.

When to Prune

Grapevines should be pruned during the dormant season.

Where winters are relatively mild, prune anytime during the dormant season when the temper-

ature is above freezing. Frozen canes are brittle and easily broken.

Where winter temperatures are low enough to injure the canes, wait until late winter or early spring when you can select uninjured canes for fruiting. Pruning prior to severe freezes can increase winter injury.

Vines pruned late in the spring will "bleed" freely, but this is not injurious. Vines pruned just before growth starts or after the buds swell leaf out a little later than those pruned earlier. While the delay in leafing out may be sufficient to avoid injury from late frosts, it is difficult to prune and tie the vines after growth starts without destroying many of the buds.

Balanced Pruning

The vigor of a mature vine indicates how much fruit it can produce. The more vigorous the vine, the more buds should be left after pruning.

Varieties for which long-cane pruning is recommended, such as Concord, should have between 30 and 60 buds after pruning. The rule of thumb is to leave a basic 30 buds (unless the vine is very weak) plus 10 buds for each pound of 1-year-old wood removed in the pruning process. Thus for a vine with 1 pound or less of prunings leave 30 buds, for 2 pounds leave 40 buds, for 3 pounds leave 50 buds, and for 4 pounds or more leave 60 buds.

Varieties for which medium-cane pruning is recommended should have 25 buds plus 10 buds

per pound of prunings, up to a maximum of 45 buds.

Large-clustered varieties should be pruned much more severely than Concord. The hybrid direct producers for which short-cane pruning is recommended should be cut back to as few as four to six buds for the first pound plus two buds for each additional pound. With some varieties it may be necessary in addition to remove all clusters except the basal one which forms on each shoot.

Begin by rough-pruning the vine to the training system selected, leaving a surplus of buds. Weigh the 1-year-old wood removed, calculate the number of buds to be left, and prune to that number.

With practice it is possible to prune without weighing wood and counting buds for every vine. Even experienced pruners, however, should weigh wood and count buds on an occasional vine to guide and check themselves in pruning.

Modifications in pruning severity may be necessary because of differences in growing conditions. For example, Concord grapevines under irrigation in Washington State are more vigorous than vines in the East. Consequently, 60 buds are left on the vine for the first pound of the past year's prunings removed and 20 buds for each additional pound removed. In Minnesota, the small-clustered Beta variety produced much greater yields when 70 to 90 buds were left than when 40 were left.

Tying Fruiting Canes

Tie the canes before the buds start to swell, because the buds are easily rubbed or knocked off. Use binder twine or some other material that will retain its strength for several months. Wire, plastic, or premium quality twine, however, may last long enough to girdle the vines in future years. Using a knot that will not slip, tie the arm tightly at the end just behind the last bud, which should be rubbed off. Other ties should be loose to allow for growth in the diameter of the vine.

Renewing Trunks

If a trunk is misshapen, damaged, or diseased, it is generally faster to develop a new trunk from the existing roots than to replace it with a new vine. If the old trunk is diseased, immediate removal is usually advisable. Otherwise, it can continue to bear a crop while the new trunk is being developed.

Train a strong sprout or sucker from the base of the old trunk to the trellis as though it were the cane of a young vine. After 2 years the framework should be established. Then greatly restrict the number of canes from the old trunk to permit the new framework to produce a good crop. The following winter (the third) remove the old trunk completely.

Treatment of Frost-Injured Vines

A late frost may severely injure the new growth of grapes. If this happens, remove all new growth—

injured and uninjured parts. Grapes have multiple buds, and when the first growth is removed a secondary bud normally develops and produces a partial crop. The crop is larger if the injury occurs when the primary growth is very short.

A few shoots on frosted vines may be uninjured. Very few secondary buds develop on such a vine—complete stripping is necessary to force secondary growth. Partial stripping results in ill-shaped vines that are difficult to prune satisfactorily the following winter. Usually, vines frosted enough to need some stripping should be stripped completely.

When the growth is long and only the tips and terminal leaves appear to be frost injured, the flower clusters may open in an apparently normal manner, then shed without setting much fruit. Under these conditions it is impossible to determine the exact degree of injury immediately after the frost. Therefore, if injury appears mild, it is safer not to strip. Such vines will produce a partial crop without stripping, and stripped vines never produce more than a partial crop.

SOIL MANAGEMENT

Cultivation

Grapes respond favorably to cultivation, and vineyards are normally cultivated at least during the spring and early part of the summer.

Cultivate shallowly—3 to 4

inches deep—to avoid serious injury to the roots. For the first cultivation, use a bottom plow, rotary tiller, or a tandem disk. Then cultivate as necessary with a springtooth harrow to keep weeds down.

If used by an experienced operator, the grape hoe is excellent for cultivating within the grape row.

The grape hoe is a manually controlled blade mounted on a tractor. It can be set to pull the surface layer of soil and weeds away from under the trellis. A second cultivation about 2 weeks later throws the soil and smothered weeds back under the trellis.

The grape hoe gets most of the weeds, leaving very few for hand hoeing. The power rotary hoe may also be used under the trellis.

Post-emergence herbicides can be used in place of this operation, but cultivation has the advantage of breaking up the life cycle of such insects as the grape berry moth and the grapevine root borer.

In hillside vineyards subject to erosion, follow a system of trashy cultivation. Keep some growth and trash on the land and keep the land rough enough to pocket and hold water. Cultivate only enough to prevent weeds from competing seriously with the vines. A tandem disk is excellent because it can be adjusted to loosen the soil without turning it.

Grapevines should be kept in vigorous condition. Weak vines set poor "stringy" fruit clusters and are unproductive. Lack of vigor is a common problem in vineyards. Cultivation and the use of nitro-

genous fertilizers stimulate weak vines.

Excessively vigorous vines also set fruit poorly, even though they blossom freely. Restricting growth at blossoming time can increase the set of fruit. A fast-growing cover crop, such as oats or rye, will compete with the vines for plant nutrients and moisture and may restrict growth. Resume normal cultivation after the fruit is set. Lack of cultivation, reducing the amount of nitrogenous fertilizer applied, and leaving more fruiting wood also help to curb excessive vigor of vines.

Restricting the growth of vigorous vines a few weeks before the fruit ripens often improves the quality of the crop and allows fruiting wood for the next year's crop to mature more fully. To restrict growth, sow a fast-growing cover crop during the summer.

Fertilizers

Fertilizer requirements vary with the kind of soil. Soils may require a complete fertilizer (nitrogen, phosphorus, and potassium) or they may require only nitrogen and potassium or nitrogen alone. In the Southeastern States, the soils generally require a complete fertilizer.

In most areas, phosphorus benefits grapes very little, but it generally aids the growth of cover crops enough to warrant its use in vineyards.

Boron, zinc, and magnesium are helpful on the poor sandy soils in the coastal States of the East and

South. In highly acid soils, lime may be necessary for the growth of legume cover crops.

Spring is the best time to apply fertilizer. Fertilizing in summer or early fall forces new shoot growth which may fail to mature before frost. Because grape roots spread out over a wide area, broadcast application works best.

Organic materials—barnyard manure, straw, hay, and grape pomace—are valuable because they build the soil. They can also supply appreciable quantities of plant nutrients. Materials such as straw and sawdust, if not well rotted when applied, require additional applications of nitrogen.

County agricultural agents and State agricultural experiment stations can advise on fertilizing.

Cover Crops

Where vineyard land is intensively cultivated, cover crops should be grown to maintain the organic matter content of the soil.

The small grains, particularly rye and oats, are good winter cover crops, because they make good growth quickly. Ryegrass is sometimes grown, but grass crops do not add nitrogen to the soil.

Grow legumes as a winter cover crop in areas where adapted. Vetch is widely adapted. Crimson clover, burclover, and blue lupine may be grown in the South.

Cover crops that are drill seeded are easier to clean out of the grape rows in the spring than those that are broadcast.

In some locations, summer cover

crops, such as soybeans, buckwheat, millet, and cowpeas, are grown as an additional source of organic matter.

CHEMICAL WEED CONTROL²

Weeds are difficult to remove from under the trellis with a grape hoe without some damage to the vines. A number of herbicides may be used to control weeds in an established vineyard. Caution must be used in applying herbicides to vineyards less than 3 years old.

Diuron, monuron, simazine, and dichlobenil are preemergence herbicides that will prevent weeds from emerging. They generally will not control established weeds. Apply them in a strip 2 to 3 feet wide under the trellis in the spring before weeds emerge. Preemer-

Do not use the dinoseb spray mixture or paraquat in a young vineyard that is just being established. They will damage succulent growth, such as leaves and young canes, that they contact.

Do not use volatile forms of 2,4-D in or near vineyards for any purpose. They are very injurious to grapes.

Do not use spray equipment that has been used to apply 2,4-D or related herbicides on other crops.

gence herbicides will control weeds over an extended period of time.

If weeds are established, spray them with a postemergence herbicide such as dinoseb or paraquat or remove them mechanically. Unlike preemergence herbicides, the postemergence herbicides have little or no residual activity.

Each of the herbicides listed in the box will control many germinating annual broadleaf weeds

Chemical Names of Herbicides

Dichlobenil.....	2,6-dichlorobenzonitrile
Dinoseb.....	2-sec-butyl-4,6-dinitrophenol
Diuron.....	3-(3,4-dichlorophenyl)-1,1-dimethylurea
Monuron.....	3-(p-chlorophenyl)-1,1-dimethylurea
Paraquat.....	1,1-dimethyl-4,4-bipyridinium ion
Simazine.....	2-chloro-4,6-bis(ethylamino)-s-triazine

Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

and weed grasses. Dichlobenil and simazine also control certain perennial weeds such as quackgrass, *Artemisia*, and Canada thistle. Paraquat or dinoseb applied to weed foliage kills annual weeds and the tops of perennial weeds.

The manufacturer's label gives a range of application rates for each of these herbicides. Specific recommendations for your area, soil type, or particular weed problem may be obtained from your county agricultural agent, State weed specialist, or State pesticide bulletins.

WINTER PROTECTION

Winter protection may be necessary in very cold areas. Also, cold-tender varieties can often be grown beyond their range if protected from winter injury. In general, delayed maturity of vines and fruit tends to increase cold injury. Several vine management techniques can prevent or lessen damage from cold:

- Control insects and diseases by spraying.
- Train vines to assure adequate exposure of leaves to sunlight.
- Prune lightly and thin flower clusters to one cluster per shoot. This will result in a larger leaf area without causing overcropping.
- Restrict growth in the fall, if necessary, by limiting nitrogen fertilization and by stopping clean cultivation early enough to permit

weeds or a sown cover crop to compete with vines.

- Follow any of the training systems described in this bulletin, but leave two trunks as in the illustration of the Geneva double curtain system (see p. 17). The two trunks are usually not injured equally, and the less severely injured one can be retained at the time of pruning. During the growing season leave a basal sprout to provide a replacement trunk.

- Delay final pruning as late as practical in the spring so that the extent of winter injury can be determined. This enables you to retain the proper number of live buds.

- If the main trunk is killed or severely injured, basal sprouts (suckers) sometimes start to grow. Retain several of these to provide enough leaf area to support the root system. Train the best one onto the trellis for a replacement trunk.

HARVESTING AND FRUIT MATURITY

Color is a poor index of maturity in bunch grapes. Many varieties change color long before they are fully ripe, and practically all varieties become sweeter and less acid as they mature.

For table grapes, maturity is usually determined by taste or by the color of the seeds, which changes from green to brown.

The harvest date for grapes for juice and wine is determined on the basis of the percentage of soluble solids or sugar content. The testing is done with a refractometer or a Balling hydrometer.

Although the highest quality fruit may be obtained by harvesting fully ripened clusters, it is sometimes necessary to harvest the crop before the fruit is fully mature to prevent loss. Some varieties tend to crack as they mature, and rain increases this tendency. On susceptible varieties, ripe-fruit rots spread rapidly during rainy weather. Where the growing season is short, a freeze or frost may damage the crop. In some locations birds do considerable damage to mature fruit unprotected on the vines. In home plantings, clusters on a few vines can be protected by bagging them with kraft bags or by covering the vines with netting.

Well-managed commercial vineyards in favorable areas generally yield 6 or more tons per acre. Yields of up to 12 tons per acre are possible in highly favorable areas.

If vines are allowed to overproduce, the sugar content of the fruit will be low, the color poor, and maturity of both fruit and wood will be delayed. Immature wood will be damaged by frost, and the next year's crop will therefore be reduced. After severe overcropping, the entire vine may be winter-killed.

INSECTS AND DISEASES

For quality fruit, American bunch grapes should be sprayed at least three times to control insects and diseases. Additional applications may be necessary in wet seasons or in areas where certain insects and diseases are more common or for disease-susceptible varieties.

Unsprayed vines in home gardens may occasionally produce fine clusters, but not as a rule. Spraying is easier than removing rotted and insect-infested berries.

Commercial growers must be able to recognize the insects and diseases that are likely to occur in their localities so that they can spray in time to prevent major damage.

For information about insects and diseases, consult your county agricultural agent.

PRECAUTIONS

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinat-

ing insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed.

In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells.

Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.